

	Chemistry https://www.doe.mass.edu/frameworks/scitech/2016-04.pdf Syllabus	
	Unit ONE: Matter	
Essential Questions	• What is matter and how can it be classified? • How do I recognize a chemical reaction?	
Science Standards	HS-PS1-11(MA). Design strategies to identify and separate the components of a mixture based on relevant chemical and physical properties. Clarification Statements: • Emphasis is on compositional and structural features of components of the mixture. • Strategies can include chromatography, distillation, centrifuging, and precipitation reactions. • Relevant chemical and physical properties can include melting point, boiling point, conductivity, and density.	
Concepts and skills	Concepts • All matter is made out of atoms • Atoms can be manipulated to make new substances. (Atoms vs Elements vs Compounds vs Mixtures) • Mixing substances causes either a physical or a chemical change. • When substances are mixed they form either heterogeneous or homogeneous mixtures. • Lab Safety Protocols. • Plan a lab procedure from given materials. • Calculate percent composition and explain its significance. • Calculate percent error and explain its significance.	Skills Science and Engineering practices - S1. Asking questions (for science) and defining problems (for engineering). - S2. Developing and using models. - S3. Planning and carrying out investigations. - S4. Analyzing and interpreting data. - S5. Using mathematics and computational thinking. - S6. Constructing explanations (for science) and designing solutions (for engineering). - S7. Engaging in argument from evidence. - S8. Obtaining, evaluating, and communicating information
Content Objectives "I can Statements"	• Engaging in argument from evidence. ○ Classify matter as a pure substance or a mixture. ○ Classify pure substances as elements or compounds. ○ Classify mixtures as heterogeneous or homogeneous. ○ Identify if a change is physical or chemical.	

	• Planning and carrying out investigations. ◦ Create a plan to separate a mixture using safe laboratory practices. • Analyzing and interpreting data. ◦ Analyze and interpret what occurs during each step of a separation of a mixture. • Constructing explanations. ◦ Use the vocabulary to construct explanations that communicate what is occurring during each step of a separation lab. • Developing and using models. ◦ Use models to show what is occurring during each step of a separation lab. • Obtaining, evaluating, and communicating information. ◦ Use the vocabulary to construct explanations that communicate what is occurring during each step of a separation lab. • Using mathematics and computational thinking. ◦ Calculate the percent composition of a mixture and determine its components. ◦ Calculate percent error AND explain its significance. • Asking questions ◦ Ask questions that further my understanding of the topic.
Assessments, products, practice	Practice: • Classification of Matter POGIL. • Nuts and Bolts of Matter/Lego Building Matter • Types of Mixtures CER. Assessment: • Observing Reactions Lab • Unit 1 Summative Assessment (includes a demonstration and modeling)
Text, Materials, and Resources	Chemistry shared drive filled with: • Slide Presentations (ppt, google, etc.) • POGILs (note packets) • CHEMQUESTs (practice worksheets) Savvas Realize

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	Unit Two: Atomic Structure	
Essential Questions	• What is the atom made of and how do we know? • What are the different ways atoms can be altered?	
Science Standards	HS-PS1-1. Use the periodic table as a model to predict the relative properties of main group elements, including ionization energy and relative sizes of atoms and ions, based on the patterns of electrons in the outermost energy level of each element. Use the patterns of valence electron configurations, core charge, and Coulomb's law to explain and predict general trends in ionization energies, relative sizes of atoms and ions, and reactivity of pure elements. Clarification Statement: • Size of ions should be relevant only for predicting strength of ionic bonding. • State Assessment Boundary: • State assessment will be limited to main group (s and p block) elements.	
Concepts and skills	Concepts • Atomic Modeling • Atoms vs Isotopes vs Ions • Weighted Average • Electron Configuration • Spectroscopy	Skills Science and Engineering practices - S1. Asking questions (for science) and defining problems (for engineering). - S2. Developing and using models. - S3. Planning and carrying out investigations. - S4. Analyzing and interpreting data. - S5. Using mathematics and computational thinking. - S6. Constructing explanations (for science) and designing solutions (for engineering). - S7. Engaging in argument from evidence. - S8. Obtaining, evaluating, and communicating information
Content Objectives "I can Statements"	• Developing and using models. ◦ Compare and contrast the Thomson and Rutherford Models of the Atom. • Analyze and Interpret data ◦ Explain Rutherford's Gold foil experiment. • Engaging in argument from evidence. ◦ Explain the evidence and reasoning for the TWO claims he made.	

	- Obtain, Evaluate and communicate: - The number of subatomic particles of an atom, ion or isotope. - Isotopic notation ex. C-12 and $^{12}_6\text{C}$ - Write ground state & possible excited state configurations for elements #1-56. - Using mathematics and computational thinking - Calculate atomic mass of an element given % abundances of naturally occurring isotopes - Analyzing and interpreting data: - Given a mass spectroscopy graph, determine the most abundant isotope of any element. - Given a mass spectroscopy graph, determine the identity of the element on the periodic table - Given a mass spectroscopy graph, determine the approximate average mass for the element - Identify unknown elements based on bright line emission spectrum mixture when given individual spectral emissions. - Constructing explanations - Explain how bright line emission spectra & colors are emitted by atoms and their electrons.
Assessments, products, practice	Practice: - Rutherford PHET Simulation - Build an Atom PHET Simulation - Mystery Atoms - Beanium - Flame Test - Atomic Spectra Assessment: - Unit 2 Summative Questions
Text, Materials, and Resources	Chemistry shared drive filled with: - Slide Presentations (ppt, google, etc.) - POGILs (note packets) - CHEMQUESTs (practice worksheets) Savvas Realize
	CHEMISTRY https://www.doe.mass.edu/frameworks/scitech/2016-04.pdf

	Syllabus	
	Unit Three: Ionic Bonding	
Essential Questions	• What is metallic bonding? How does it occur in the world around us? • What is ionic bonding? How does it occur in the world around us?	
Science Standards	HS-PS2-6. Communicate scientific and technical information about the molecular-level structures of polymers, ionic compounds, acids and bases, and metals to justify why these are useful in the functioning of designed materials. Examples could include comparing molecules with simple molecular geometries; analyzing how pharmaceuticals are designed to interact with specific receptors; and considering why electrically conductive materials are often made of metal, household cleaning products often contain ionic compounds to make materials soluble in water, or materials that need to be flexible but durable are made up of polymers.	
Concepts and skills	Concepts • Electron Transfer ○ Atomic Radius ○ Ionization Energy ○ Electronegativity ○ Ionic Radius (HONORS) • Opposite Charges Attract • Delocalized Electrons vs Electrostatic Attractions • Properties of Metallic and Ionic Bonds • Lewis Dots Structures • Nomenclature • Formula Writing	Skills Science and Engineering practices S1. Asking questions (for science) and defining problems (for engineering). S2. Developing and using models. S4. Analyzing and interpreting data. S5. Using mathematics and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information
Content Objectives "I can Statements"	• Developing and using models. ○ Develop a model of metallic bonding ○ Model the formation of an ionic bond, and the resulting charge on each ion. ○ Model the transfer of electrons from one atom to another in the formation of an ionic bond, in terms of electronegativity and ionization energy. (Honors only) ○ Create models of Lewis Dot structures for ionic compounds.	

	○ Model an ionic solid. ■ Paying special attention to the relative sizes of the ions. (Honors only) ○ Model and explain the trend for atomic radius. (Honors only) ○ Model and explain the trend for electronegativity. (Honors only) ○ Model Ionization energy (first, second, third...) and explain the difference in energy when removing a valence electron vs. a core electron. (Honors only) ○ Model the relative size of any atom and ion. (Honors only) ● Analyzing and interpreting data ○ Analyze and interpret data to determine the characteristics of metallic substances. ○ Analyze and interpret data to determine characteristics of ionic compounds. ○ Analyze and interpret the name of an ionic compound to write its formula. ○ Analyze and interpret the name of an ionic compound that contains a polyatomic ion to write its formula. ○ Analyze data to determine what roman numeral is needed in the name of an ionic compound. (Honors only) ○ Analyze and interpret ionization energy data to determine the following: (Honors only) ■ number of valence electrons an atom has ■ the group number of an element (group name) ■ the identity of an element given the period number ● Construct an Explanation ○ Construct an explanation as to why roman numerals are used in some names of ionic compounds, and not in others. ● Obtaining, evaluating, and communicating information ○ Research and communicate information about substances that contain metallic bonding. ○ Research and communicate information about compounds that have an ionic bond.
Assessments, products, practice	Practice: ● Whiteboards ● Worksheets ● Ionic Puzzle Formulas ● Ionic Dice Game Assessment: ● Unit 3 Summative Questions
Text, Materials, and Resources	Chemistry shared drive filled with: ● Slide Presentations (ppt, google, etc.) ● POGILs (note packets) ● CHEMQUESTs (practice worksheets) Savvas Realize

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	Unit Four: Covalent Bonding	
Essential Questions	What is covalent bonding? How does it occur in the world around us?	
Science Standards	HS-PS1-3. Cite evidence to relate physical properties of substances at the bulk scale to spatial arrangements, movement, and strength of electrostatic forces among ions, small molecules, or regions of large molecules in the substances. Make arguments to account for how compositional and structural differences in molecules result in different types of intermolecular or intramolecular interactions. Clarification Statements: - Substances include both pure substances in solid, liquid, gas, and networked forms (such as graphite). - Examples of bulk properties of substances to compare include melting point and boiling point, density, and vapor pressure. - Types of intermolecular interaction HS-PS2-6. Communicate scientific and technical information about the molecular-level structures of polymers, ionic compounds, acids and bases, and metals to justify why these are useful in the functioning of designed materials. Examples could include comparing molecules with simple molecular geometries; analyzing how pharmaceuticals are designed to interact with specific receptors; and considering why electrically conductive materials are often made of metal, household cleaning products often contain ionic compounds to make materials soluble in water, or materials that need to be flexible but durable are made up of polymers.	
Concepts and skills	- Properties of Metallic vs Ionic vs Covalent Bonding - Write names/formulas for Covalent Molecules - Polar vs Nonpolar Covalent Bonds - Polar vs Nonpolar Covalent Molecules - Molecular Geometry (VSEPR)	Science and Engineering practices S1. Asking questions (for science) and defining problems (for engineering). S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S5. Using mathematics and computational thinking.

	• Network Solids • Lewis Dot Diagrams	S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information
Content Objectives "I can Statements"	• Developing and using models. ○ Draw Lewis Dot diagrams for covalent compounds: ■ That obey the octet rule ■ That are electron deficient (Honors only) ■ That have expanded octets (Honors only) ○ Draw Lewis Dot Diagrams for Polyatomic Ions ○ Draw Lewis Dot diagrams of resonance molecules. (Honors only) • Obtaining, evaluating, and communicating information ○ Compare and Contrast properties of covalent compounds, ionic compounds and metallic substances • Constructing explanations (for science) ○ Describe covalent bonding and how electronegativity influences the bond to be non-polar or polar. ○ Explain why Group 18 monoatomic elements don't bond. • Analyzing and interpreting data. ○ Identify the polarity of a molecule based on the VSEPR shape and its Lewis dot diagram. ○ Use VSEPR to predict the shapes of molecules & their bond angles "above the line" only. (Honors only) ○ Name covalent compounds given the chemical formula ○ Write formulas for covalent compounds given the name ○ Define hybridization. Explain why it occurs and how the three types of hybridized orbitals occur. (Honors only) ○ Describe the bonding in a network solid. Give examples of network solids. How does this type of bonding affect the properties of the substance? (Honors only) ○ Describe how and why resonance in some molecules. (Honors only)	
Assessments, products, practice	Practice: • Whiteboards • Worksheets • Molecular Modeling Kits • Collisions Software	

	Assessment: Unit 4 Summative Questions
Text, Materials, and Resources	Chemistry shared drive filled with: - Slide Presentations (ppt, google, etc.) - POGILs (note packets) - CHEMQUESTs (practice worksheets) Savvas Realize

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	Unit 5 Reactions:	
Essential Questions	What are chemical reactions? How do they take place in the world around us?	
Science Standards	<i>HS-PS1-2. Use the periodic table model to predict and design simple reactions that result in two main classes of binary compounds, ionic and molecular. Develop an explanation based on given observational data and the electronegativity model about the relative strengths of ionic or covalent bonds.</i> <i>Simple reactions include synthesis (combination), decomposition, single displacement, double displacement, and combustion.</i> <i>Predictions of reactants and products can be represented using Lewis dot structures, chemical formulas, or physical models.</i> <i>Observational data include that binary ionic substances (i.e., substances that have ionic bonds), when pure, are crystalline salts at room temperature (common examples include NaCl, KI, Fe₂O₃); and substances that are liquids and gases at room temperature are usually made of molecules that have covalent bonds (common examples include CO₂, N₂, CH₄, H₂O, C₈H₁₈).</i> <i>HS-PS1-7. Use mathematical representations and provide experimental evidence to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</i> <i>Mathematical representations include balanced chemical equations that represent the laws of conservation of mass.</i>	
Concepts and skills	- Writing and Balancing Chemical Reactions u - Identify 5 types of Reactions - Synthesis - Decomposition	Science and Engineering practices S1. Asking questions (for science) and defining problems (for engineering). S2. Developing and using models.

	○ Single Displacement ○ Double Displacement ○ Combustion ● Predict favorability of SRR with Activity Series ● Predict products of DRR & identify precipitate with Solubility Rules	S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S5. Using mathematics and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information
Content Objectives "I can Statements"	● Developing and using models ○ Model chemical reactions by creating balanced chemical equations with lowest whole number coefficients. ○ Model whether a single replacement reaction is favorable or unfavorable using the activity series. ○ Model a single replacement reaction to predict the products and balance. ○ Model and balance a double replacement reaction, and predict the products. ○ Create a model of a net ionic equation and Identify spectator ions. ● Analyzing and interpreting data ○ Analyze and interpret data to determine that a chemical reaction has taken place. ○ Analyze data to determine the 5 types of chemical reactions given a chemical equation. ○ Analyze data to identify the precipitate formed in a double replacement reaction using the solubility chart. ● Obtaining, evaluating, and communicating information ○ Evaluate and communicate the Law of Conservation of Matter and how it applies to chemical reactions.	
Assessments, products, practice	POGIL: Types of Chemical Reactions LOCOM LAB (if not completed in Unit 1: Matter) Observation “Baggie” LAB (if not completed in Unit 1: Matter) DEMOS $\text{Al} + \text{CuCl}_2 \rightarrow ?$ $\text{Cu} + \text{AgNO}_3 \rightarrow ?$ $\text{Pb}(\text{NO}_3)_2 + \text{KI} \rightarrow ?$ MICRO Activity Series LAB working with Single Replacement Reactions DRR LAB Identify precipitates from Solubility Rules	

	The Product is Chalk LAB • identification of reactants
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	Unit Six: RedOx Reactions	
Essential Questions	What is the mechanism and driving force behind oxidation reduction reactions? How do redox reactions take place in the world around us?	
Science Standards	<i>HS-PS1-10. Use an oxidation-reduction reaction model to predict products of reactions given the reactants, and to communicate the reaction models using a representation that shows electron transfer (redox). Use oxidation numbers to account for how electrons are redistributed in redox processes used in devices that generate electricity or systems that prevent corrosion.</i> • <i>Reactions are limited to simple oxidation-reduction reactions that do not require hydronium or hydroxide ions to balance half-reactions.</i>	
Concepts and skills	• Assign oxidation states • Give examples of common Redox reactions ◦ Potato Clock • Galvanic Cells • $\frac{1}{2}$ Reactions • Electrolysis / Electroplating	Science and Engineering practices S1. Asking questions (for science) and defining problems (for engineering). S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S5. Using mathematics and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering).

		S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information
Content Objectives "I can Statements"		
Assessments, products, practice	RedOx Titration LAB , identify unknown salt Decomposing Zinc Iodide, predicting products and oxidation states Oxidation Reduction in a Shake: $\text{Zn} + \text{CuSO}_4$ Build Galvanic Cells LAB	
Text, Materials, and Resources	Chemistry shared drive filled with: • Slide Presentations (ppt, google, etc.) • POGILs (note packets) • CHEMQUESTs (practice worksheets) Savvas Realize	